Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia - Social and Behavioral Sciences 51 (2012) 883 – 887

Procedia
Social and Behavioral Sciences

ARTSEDU 2012

Parallel computing in training of informatics teachers

Bairbekova Gaziza[a]*, Nugmanova Salima[b], Kamalova Guldina[c], Kisseleva Elena [d]

[a]*Furmanov str 187, Almaty 050013, Kazakhstan*
[b]*Furmanov str 187, Almaty 050013, Kazakhstan*
[c]*Furmanov str 187, Almaty 050013, Kazakhstan*
[d]*Furmanov str 187, Almaty 050013, Kazakhstan*

Abstract

Had been accumulated learning experiences for students in integrated computer science courses the form of education and the content of teaching still remain traditional. There is a need to redefine the system of professional competence of future teachers of computer science, which take into account the problems of training in the field of parallel computing. In the article the complex of knowledge and skills, required in this area, is analyzed, and the set of competencies, which form a single structure of the integrated course of parallel computing, is determined.

*Keywords:*parallel computing, OpenMP, parallel programming, PVM;

1. Introduction

Please do not alter the formatting and style layouts which have been set up in the template document Procedia S+BS_template.dot.

As indicated in the template, papers should be prepared in single column format suitable for direct printing onto A4 paper (8.3in x 11.7in/210mm x 297mm). Do not number pages as page numbers will be added later in the publication process. Leave a line clear between paragraphs.

All the required style templates are provided in the file Procedia S+BS_template.dot with the appropriate name supplied, e.g. choose 1. Els1st-order-head for your first order heading text, els-abstract-text for the abstract text.

2. Heading styles

At our time swift development of sciences, both fundamental and applied, which use complicated realistic (multidimensional, multiparametric) mathematical models, is observed. This in combination with rapid technological progress brought to significant increase of the need in application of powerful computer equipment. During last decades supercomputers has been used in solving actually any tasks of science and technology. Such tasks include modeling of different physical processes, problems of computer chemistry and biology, nanotechnology, automation of designing, and many other tasks.

*Bairbekova Gaziza. Tel.: +7-705-702-9500
E-mail address: tur0n3@mail.ru

1877-0428 © 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of Prof. Ayşe Çakır İlhan
Open access under CC BY-NC-ND license. doi:10.1016/j.sbspro.2012.08.257

In connection with wide dissemination of parallel computers the interest to parallel computing has increased. This is mainly connected with two factors. The first factor is defined by scientific and technical progress, as a result of which new fields of knowledge demanding application of methods of mathematical modeling have appeared. The models themselves have also become significantly more complicated. As a result, increase of the need in resource-intensive computing, which in a range of cases can be performed only on the basis of highly efficient equipment with the help of methods of parallel or distributed computing, takes place. Another significant factor, which has brought to increase of the interest to parallel computing, is wide dissemination of parallel computers. At our time multiprocessor servers can be found at medium and big enterprises, banks, and in research institutes and centers. In connection with appearance of multinuclear processors many users have become owners of mini-supercomputers at their places of work.

Significant progress in the sphere of networks technologies has permitted to use local networks of enterprises and training rooms for parallel computing, and made creation of cheap computing clusters possible.

Availability of several processor assemblies is common for different types of parallel architectures. Upon the type of interaction of processor assemblies between themselves, parallel systems are divided into systems with common and distributed memory. In systems with common memory all processors have access to the single space of memory. The data exchange between processors is made as follows: one processor records data upon a certain address, and another processor reads them. This class includes multiprocessor working stations and servers, supercomputers with common memory (for example, HP Superdome), and also multinuclear processors having been widely disseminated in recent time.

Systems with common memory are convenient as to development of parallel programs and provide high efficiency, and with a big number of processors they are very expensive. Systems with distributed memory are an alternative of lower costs. In such systems every processor has access only to its local memory, and between themselves processors interact with the help of transfer of messages through the networks. This class includes highly efficient computing clusters, and also local networks.

Differences in the architecture also predetermine differences in paradigms of programming. For systems with common memory the basic paradigm is multithreaded programming, where different threads of management make an access to the single memory space. Pthreads library and OpenMP packet are classic tools for such systems.

The most widely-spread method of creation of parallel applications for systems with distributed memory is organization of processes interacting with the help of transfer of messages. MPI (Message Passing Interface), PVM (Parallel Virtual Machine) libraries and many other not less known means of programming are based on this paradigm.

Finally, one can decisively state that parallel information technologies turned into a required component of the complex of knowledge of the modern software developer from highly specialized discipline.

At present time possibilities of parallel information processing significantly outstrip the level of preparedness of majority of specialists and users which is required for efficient use.

Parallel information processing is based on use of parallel algorithms of processing. In order to be able to work with special software and create own products with use of parallel algorithms and languages of parallel programming it is required to obtain relevant knowledge.

The changing infomedia, means of information processing are becoming the reason of change of the system of training of informatics teachers, mainly the contents of the system. Development and improvement of parallel

algorithms and also learning of languages of parallel programming are related to prospective trends of informatics developments, which are to be reflected in the contents of preparedness of informatics teachers.

As parallel computations more widely cover different spheres of life activity of the modern society, it is becoming clear that the informatics teacher is to know and understand possibilities of application and analysis of algorithms both in traditional sequential model of computing and in different parallel models. Prospects of development of the computer engineering and informatics have formed the necessity of teaching the fundamental course of parallel computing to future teachers. With competent approach just solution of tasks of parallel computing and use of tools of parallel programming can help to reveal the level of development of abilities of students for performance of operations of content-logic thinking.

However, though positive experience of integrated courses teaching to students has been gained, forms and contents of teaching remain traditional and acceptable for one certain discipline. The necessity of redefining the system of professional competences of future informatics teachers, who would take into account problems of training in the sphere of parallel computing, arises.

2. THEORETICAL FRAME OF THE RESEARCH

One of prospective trends of reformation of the modern higher education is promotion of the competent approach in training of specialists in different fields, including in training of informatics teachers, as the priority one. At present time in

conditions of market economy, that demands rapid entry of a young specialist into profession, not only high level of professional qualification, but certain professionally significant merits of the personality raising competitiveness of the specialist – ability to master quickly new technological processes and specialties, and raise professional level – are of importance. Such merits are especially important in formation of professional competence of informatics teachers as modern information and communication technologies (ICT) significantly develop both during the time of training the specialist at the institute of higher education and in the process of its practical activity at school. Consequently, ability of self-education, self-development, and independent mastering of innovations is to become one of important competences of specialists of this sphere.

At competent approach the total number of lessons can be reduced, but they are to turn into main correcting points of development of the student's competences. The total group of students is to be divided into small groups (2-3 men), participants of the project or circle of interests, with which the teacher is to carry out the work practically individually.

As the basic purpose of the competent approach is to be development or formation of certain competences, then the next step of our research is development of the structure of the specialist's competences. Many scientific works are devoted to the problem of development of specialists' competences. The majority of authors divide competences into the group of key (supraprofessional, basic) and professional (special, professionally significant) competences. Professional competences of the informatics teacher can be divided into pedagogic and subject-specific competences. We mark the following competences of the future informatics teacher:

- key (value-meaning, general cultural, socio-labor, informational, communicative, self-educational);
- pedagogic (technological, cognitive, psychological, regulatory, research, and methodic), and
- subject-specific (user, information-system, technical, algorithmic, logic, networking, object-directed).

Analysis of the modern state of development of computer engineering and system of higher professional education showed the necessity of introduction of elements of parallel programming to the system of subject-specific training

of teachers of informatics. At present time ideas and technologies of parallel computing are applied not only to powerful computing machines, but to personal computers and notebooks. Methods of parallel programming for solving tasks differ from methods of logic, functional, and structural programming, adding them with new stages.

In this connection, the future informatics teacher is to have the following professional competences:

Scientific and research activity:

- ability of demonstration of general scientific basic knowledge of natural sciences, mathematics, and informatics; understanding of basic facts, concepts, principles of theories connected with applied mathematics and informatics;
- ability to gain new scientific and professional knowledge using modern educational and information technologies;
- ability to understand the modern mathematical apparatus and use it in research and applied activities;
- ability to solve tasks of professional activity in research and production groups;
- ability to critically review the gained experience, change the type and nature of its professional activity when required;

Project and production-and-technological activity:

- ability to execute the target search for information about up-to-date scientific and technologic achievements from Internet and other sources;
- ability to collect, process and interpret data of modern scientific researches required for formation of conclusions on relevant scientific, professional, social, and ethic problems;
- ability to form opinions on significance and consequences of its professional activity taking into account social, professional, and ethic positions;
- ability to solve tasks of production and technologic activity at the professional level, including development of algorithmic and software solutions in the field of system and applied programming;
- ability to apply modern programming and database languages, operating systems, electronic libraries and program packages, and networks technologies in professional activity;

Organizational and management activities:

- ability to gain and use organizational and management skills in professional and social activities;
- ability to make and control the plan of works to be performed, to plan resources required for performance of works, and to assess results of own work;
- ability to use bases of protection of the production staff and population against possible consequences of accidents, catastrophes, disasters and use of modern means of destruction, and basic measures of liquidation of their consequences, ability of general assessment of conditions of life safety;

Pedagogic activity:

- ability to use methods of teaching academic disciplines;
- ability to use modern methods of pedagogics and teaching means in practice;

- Activity in the field of supercomputers and parallel programming:
- ability to use the apparatus of mathematical modeling in solving applied and scientific tasks on supercomputers;

- ability to develop parallel versions of sequential algorithm of solving the task and their program implementation;
- understanding of principal possibilities and fields of use of parallel computations, including understanding of new theoretical and resource restrictions of methods and technologies of data processing with the help of supercomputers;
- ability to process results received in the course of experiments on supercomputers, to analyze and comprehend them taking into account available scientific and technologic achievements in the sphere of High-Performance Computing.

3. CONCLUSION

Requirements of the society to development of human abilities in the processing of big volumes of information by means of modern multiprocessor systems define necessity of purposeful formation of relevant thinking skills and activity. This task can be and must be solved by the informatics teacher. In this connection studying of principles of parallel computing and parallel programming is to become a part of professional training of the future teacher of informatics in pedagogic institutes.

Making some resume, it should be noted that planning and analysis of results of professional education on the basis of competences are the sole reliable method of comparison of quality of education and curricula implemented at higher school. Results of training presented as competences facilitate the transfer and accumulation of credits and also permit to accurately state students' achievements for which credits are or were assigned. Formulated competences permit to provide high quality training of informatics teachers in the sphere of supercomputers and parallel programming.

References

Kazvonina A.V. "Methods for parallel processing of information as a component of the content of the preparation of future science teachers", //2006, "Autoreferat na soiskatelya k.p.n"

Bidaibekov E.I., Kamalova G.B., Nugmanova C.A. "Parallel computing in the curriculum of teacher training universities." / /Vestnik KazNPU imeny Abay. № 1 (12) .2005. p 64-69

Voevodin V.V., Voevodin Vl.V. "Parallel Computing" //Saint-Petersburg "BHV-Petersburg."2002